CREATING AND VALIDATING A MICROSCOPIC PEDESTRIAN SIMULATION TO ANALYZE AN AIRPORT SECURITY CHECKPOINT

2015 Winter Simulation Conference,

Huntington Beach, CA

Martin Jung
Mail: m.jung@dlr.de

Initial situation

- International medium size airport
- About 10 Mio. passengers (PAX) per year
- 2 Terminals
- About 8000 Pax per day pass throw the concerned terminal security checkpoint
- Two main waiting peaks
- Queue reach's outside the security area

Requirements specification

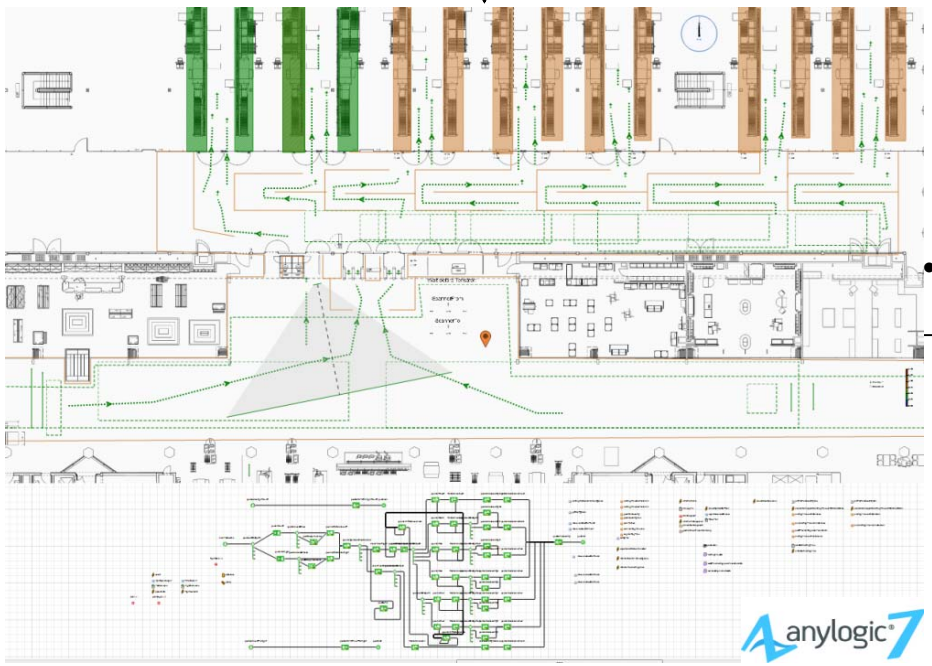
- Analyze waiting times and throughput
- Easily change main impact parameter of the security checkpoint
- Test new security procedures
- Flight plan with more passengers
- Optimize security operation schedule

let's get started

- Process specification
- Input Parameter
  - Flight plan
    - Schedule of flights
    - Number of PAX booked on every flight
  - Opening periods security lane
  - Process times
  - Arrival distribution based on passenger survey
  - Ground plans

Implementation

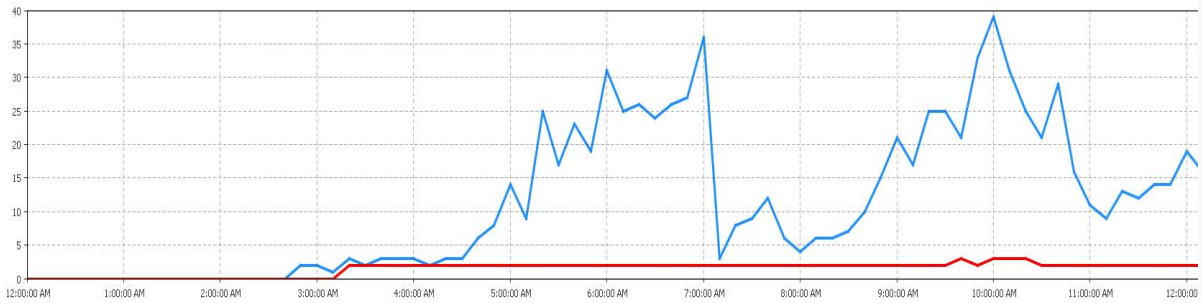
@Runtime
- Opening periods of every security lane
- Process times



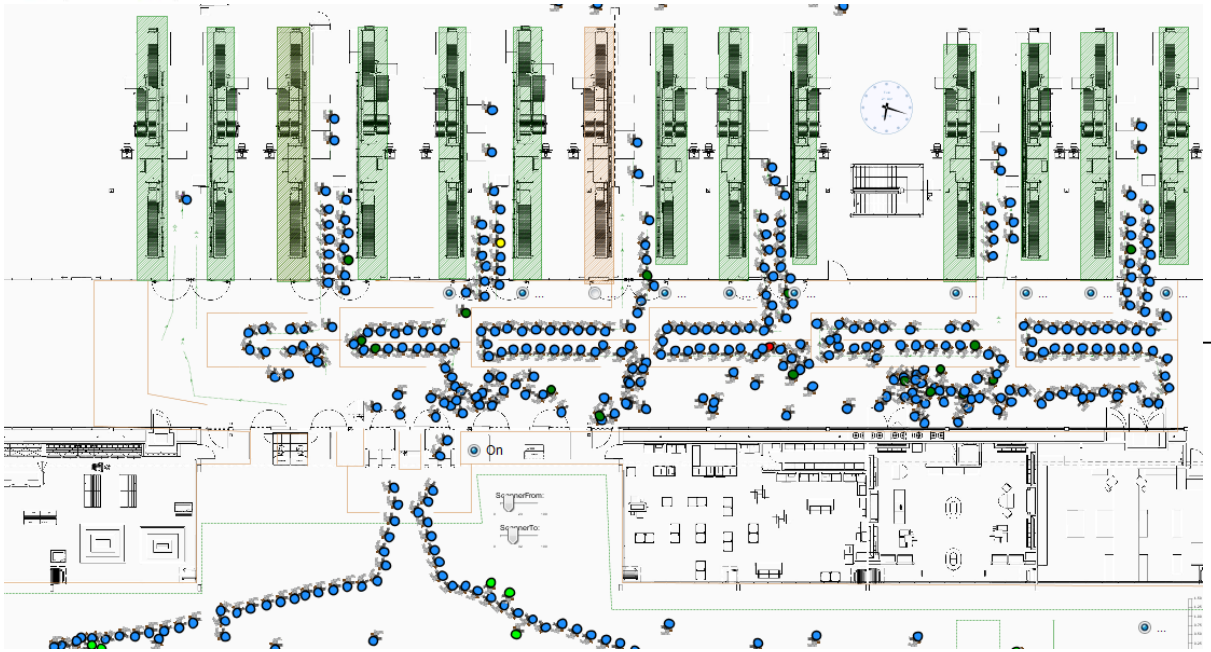
- Flight plan
  - Schedule of flights
  - Number of passengers
- Opening periods security lane
- Passanger arrival distribution

- Output
  - Next slide

Simulation Output



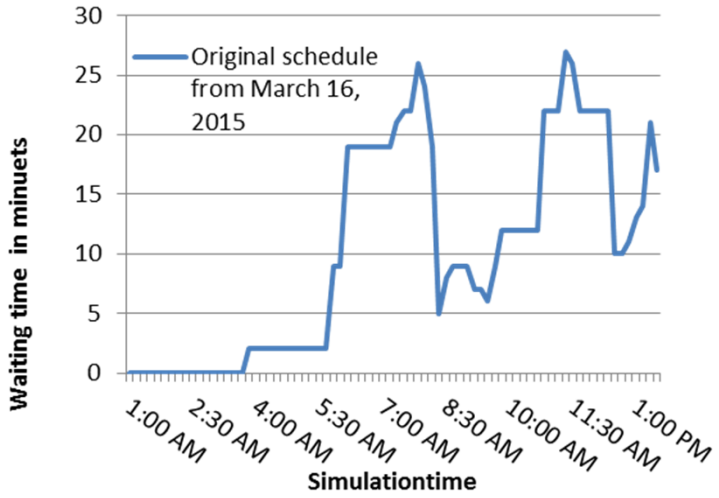
paxSumInSimulation: 58
paxSumProcessed: 4006
MaxWaitingTimeInMinutesEco: 46
MaxWaitingTimeInMinutesBus: 3
NoOfPaxWaitingMoreThan35Min: 94
SecLaneOpenMinutes: 5220
AvgWaitingTimeEco: 17



log file

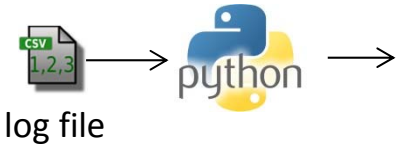
Validation

- Feedback meetings with different airport practitioners
- Real World observations
- Iterative development
- Which processes are missing or can be skipped?
- Data records from the airport
  - Planned and realized security operation schedule
  - Observed queue lengths
  - Waiting times
- Analyze log files

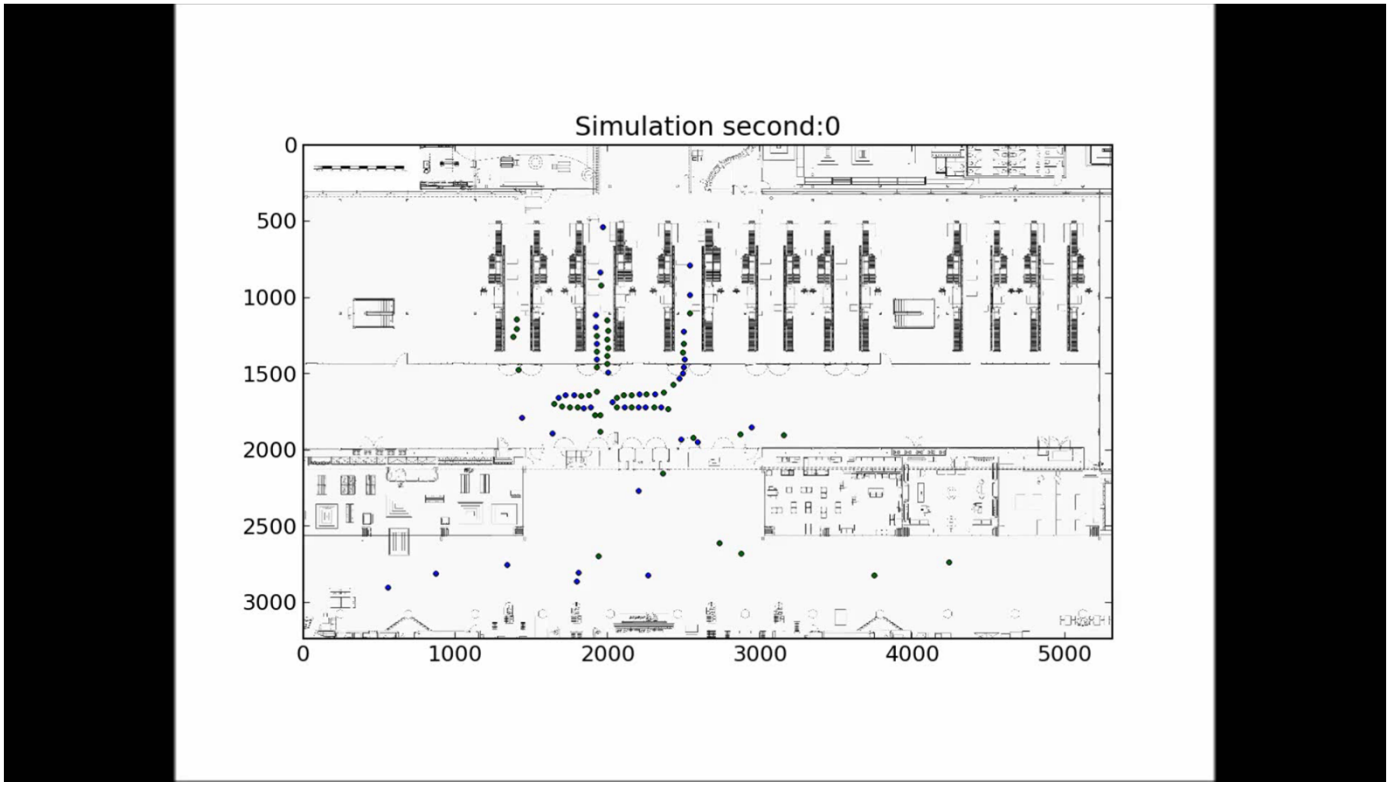


Validation

- Movie in Python
- Passenger that wait more than 35 minuets

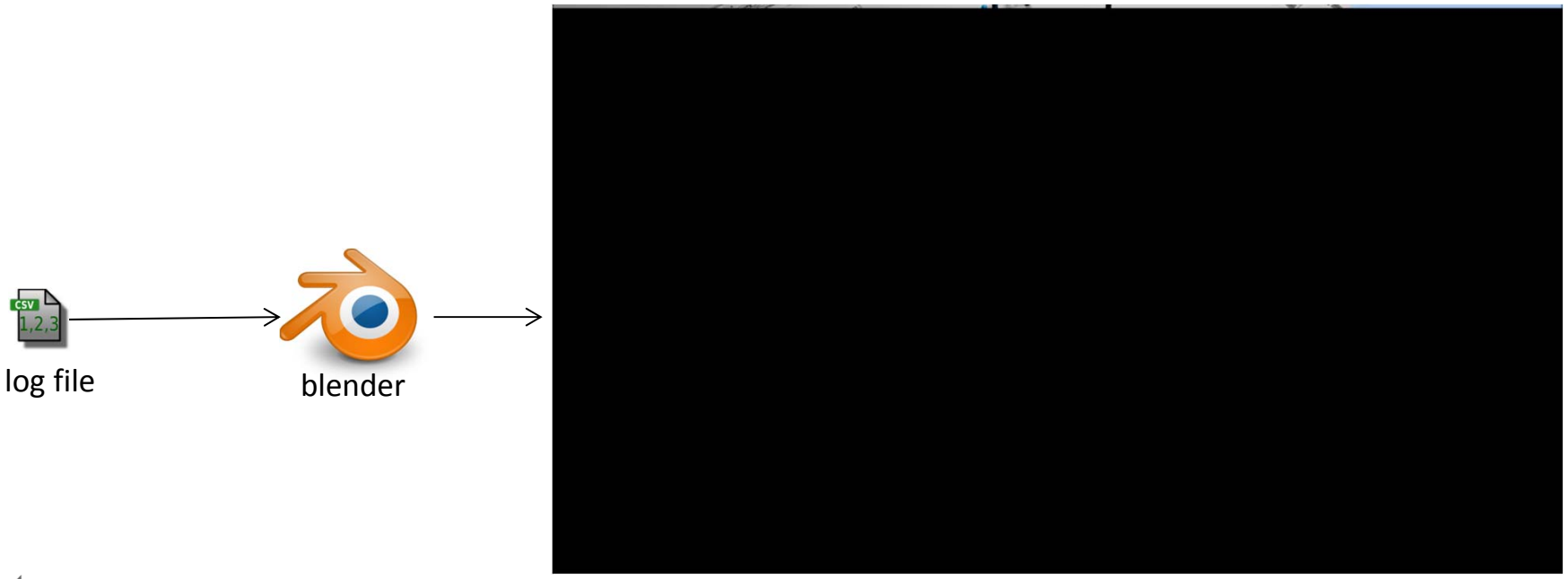


log file



Validation

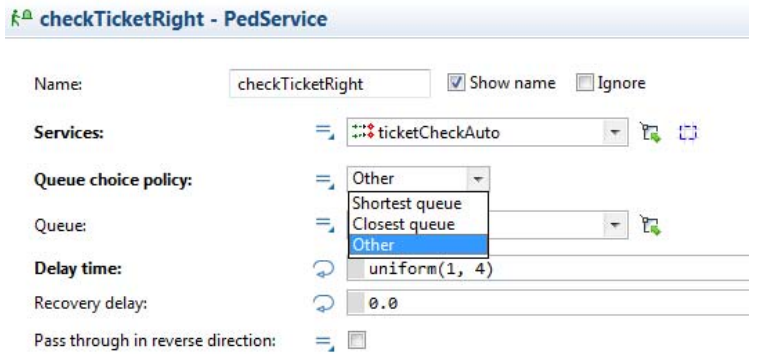
- Movie in Blender
  - Waiting Time
    - Lower 10 min. ->blue
    - 10 to 20 min. ->yellow
    - More than 20 min. -> red

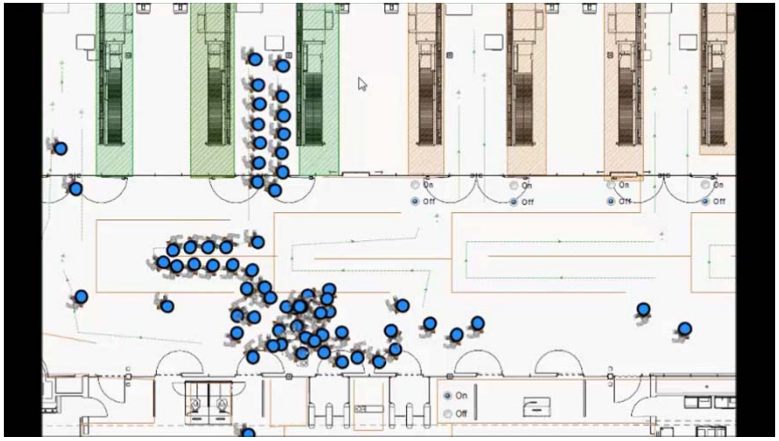


Validation – Improvement

Refinement of the Queue choose algorithm

- Reality is a mix of shortest and closest queue
  - Passenger take closest queue if lengths differ by a small amount
  - Check every 3 minutes or when a new queue opens if there is “a better queue”
  - Not everyone takes the better queue

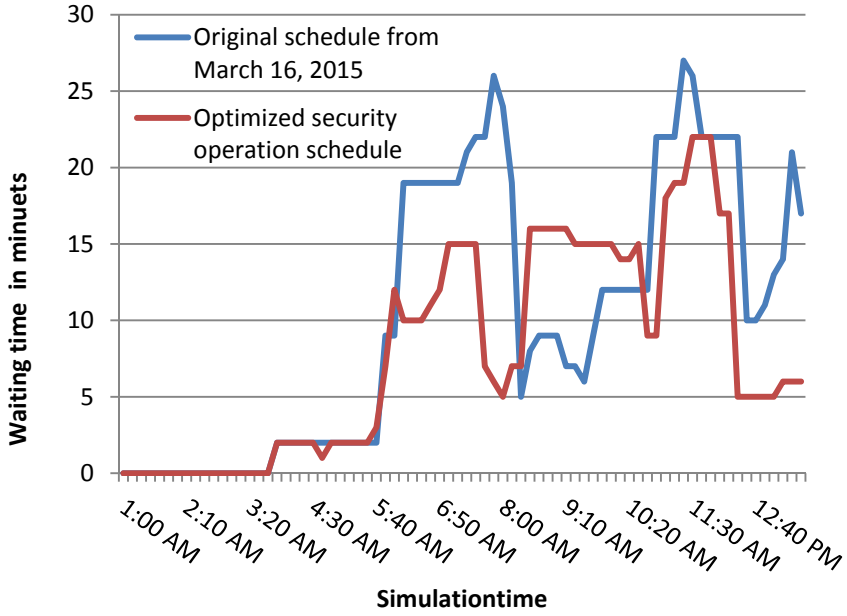




Optimization

Varying schedule of the security operations plan

- Reduce the maximum waiting time between 6:00 and 8:00 am from over 25 minutes to 15 minutes and between 10:30 to 12:30 from 26 to 22 minutes. („De-Peaking“)
- Reduce the average waiting time decreased from 17 to 12 minutes
- All with the same amount of staff



next steps

- Use the built-in optimization software optquest® to determine an optimum resource management by balancing waiting time and operating costs
- Bring the optimized plan from simulation to the “real world”
- Bring in more different agents types
  - Families
  - Elderly passengers
- Export Simulation to virtual reality enviroment (e.g. Oculus Rift)
- Incorporating train-arrival schedules in the simulation, as arriving trains also induce passenger peaks at the security checkpoints
- Optimatzion of “space usage”
- Incorporating dynamic tensator-belts

Thank you for your attention